Exhibit S

Single-Incision Mini-Sling Compared With Tension-Free Vaginal Tape for the Treatment of Stress Urinary Incontinence

A Randomized Controlled Trial

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OBJECTIVE: To compare the efficacy of a single-incision mini-sling, placed in the "U" position, with tension-free vaginal tape (TVT) in the treatment of stress urinary incontinence.

METHODS: Women with urodynamic stress incontinence with or without genital prolapse were randomized to receive a mini-sling or TVT (N=263). Those randomized to the mini-sling received two "sham" suprapubic incisions to facilitate blinding. The primary outcome was subjective cure (absence of any urinary incontinence or retreatment) as assessed at 1 year. This trial was a noninferiority study design.

RESULTS: Participants receiving the mini-sling were less likely to have a bladder injury (0.8% compared with 4.8%; *P*=.0.46), more likely to be discharged without a catheter (78.5% compared with 63%; *P*=.008), and had less pain for postoperative days 1–3. One year after surgery, the rate of cure was similar between treatment groups (mini-sling 55.8% compared with TVT 60.6%; mean difference, 4.8%; 95% confidence interval, −16.7 to +7.2); however, this did not meet our predefined noninferiority criteria of −12%. Incontinence severity at 1 year was greater with the mini-sling than with TVT (mean severity score ± SD: 2.2±2.7 compared with 1.5±1.9; *P*=.015), resulting predominantly from a higher proportion of participants with "severe" incontinence postoperatively (16% compared with 5%; *P*=.025).

CONCLUSION: The mini-sling placed in the "U" position results in similar subjective cure rates to TVT 1 year after surgery but postoperative incontinence severity is greater with the mini-sling than with TVT.

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LEVEL OF EVIDENCE: I

Synthetic mid-urethral slings are effective minimally invasive procedures for the treatment of stress urinary incontinence (SUI) that can be performed in the ambulatory setting and can be placed via either the retropubic or transobturator approach. Clinical trials suggest mid-urethral slings are as effective as traditional slings and open and laparoscopic colposuspension, but with fewer postoperative complications.[1,2] Tension-free vaginal tape (TVT), a retropubic sling, was the first commercially available synthetic mid-urethral sling and remains one of the most

For a list of members of the Foundation for Female Health Awareness Study Group, see the Appendix online at http://links.lww.com/AOG/A276.

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popular and widely studied mid-urethral slings.[1,2] It is increasingly considered the standard of care for the surgical correction of SUI. Recognized complications of retropubic mid-urethral slings include voiding dysfunction and the potential for bowel, bladder, and vascular injuries.[1–3] Transobturator slings were introduced to avoid the potential complications associated with retropubic placement. Clinical trials have demonstrated that transobuturator slings are associated with equivalent subjective cure rates to retropubic slings, with less voiding dysfunction and fewer bladder perforations.[1,2,4,5] However, transobturator slings have lower objective cure rates and have greater risk of postoperative neurologic symptoms in the obturator region.[1,2,5]

TVT SECUR is a single-incision sling procedure for SUI that is meant to be less invasive by avoiding the blind trocar passage through the retropubic or transobturator spaces associated with standard mid-urethral slings. As such, it has the potential for fewer complications, less postoperative pain, and decreased anesthesia requirements than standard slings. This device consists of an 8-cm polypropylene mesh with ends coated with an absorbable fleece material to provide fixation. This device can be placed using a retropubic or "U" approach, or a transobturator-like "hammock" approach. Clinical trials evaluating single-incision mini-slings are limited, but one study found similar cure rates between the "U" and hammock approaches with objective and subjective cure rates of 84% and 76%, respectively; however, quality of life and treatment satisfaction favored the "U" approach.[6] The objective of this study was to compare efficacy of a single-incision mini-sling placed in the "U" position with retropubic TVT in the treatment of SUI in patients with and without concurrent pelvic organ prolapse. Specifically, our aim was to test the hypothesis that the mini-sling is not inferior to TVT in this patient population.

MATERIALS AND METHODS

Portions of the Materials and Methods section have been published previously[4] and are repeated herein. The institutional review boards at each of the seven participating U.S. medical centers approved this study and all patients provided written informed consent for participation. All methods and definitions conform to the standards proposed by the International Continence Society and the National Institutes of Health unless otherwise stated.[7–9]

Participants were eligible if they were at least 21 years of age, demonstrated urodynamic SUI on multichannel urodynamic testing, and desired surgical treatment for their incontinence. Exclusion criteria included: detrusor overactivity on urodynamic testing;[2] a postvoid residual volume greater than 100 mL; history of previous synthetic, biologic, or fascial suburethral sling surgery; desires future childbearing; were currently using anticoagulation therapy or had a known bleeding diathesis; had a current urethral diverticulum or fistula of the lower urinary tract; or otherwise had a contraindication for surgery. Patients with pelvic organ prolapse requiring concurrent surgery correction were eligible for the study.

Before surgery, all individuals underwent a standardized evaluation, which included a urogynecologic history, evaluation of urethral mobility, a pelvic organ prolapse quantification examination,[8] and a urodynamic evaluation (uroflowometry, a cystometrogram, abdominal leak point pressure assessment, and a pressure-flow voiding study). Additionally, individuals completed several patient-reported outcome measures (the Incontinence Severity Index,[10] Pelvic Floor Distress Inventory short form-20,[11] Pelvic Floor Impact Questionnaire short form-7,[11] the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire short form-12 ([12]) as well as a 3-day bladder diary.

Using computer-generated random allocation with randomly permutated block, individuals were randomized to TVT or mini-sling (1:1). Randomization was stratified by study site and presence or absence of pelvic organ prolapse beyond the hymen. Consecutively numbered, sealed, opaque envelopes were used to conceal the group assignment before randomization. These were opened in the operating room just before the individuals' surgical procedures. To reduce possible patient bias and ascertainment bias, both the individual and research staff performing postoperative evaluations were blinded to treatment assignment throughout the course of the study. To maintain masking, two small, 1-cm, sham, partial-thickness skin incisions were made in the suprapubic region in those individuals enrolled in the mini-sling arm to mimic the visible incisions of TVT and covered with a steri-strip or surgical adhesive. A research nurse at each site who remained blinded to the surgical treatment perform all assessments of objective outcomes, including the postoperative bladder diaries, pelvic organ prolapse quantification examinations, incontinence severity index, and quality of life and sexual function questionnaires.

All study surgeons had extensive experience with TVT and had performed at least five mini-sling procedures before enrolling patients in the study. Method of anesthesia was left to the discretion of the

study surgeon. Tension-free vaginal tape procedures were all performed using the vaginal or "bottom-up" approach as described by the manufacturer (Ethicon Women's Health and Urology). Surgeons were instructed to set the tension of the TVT slings so they were "tension-free" so that a spacer could be placed between the sling and the urethra. Mini-sling procedures were performed using the retropubic "U" approach and, in contrast to TVT, surgeons were instructed to set the tension of the mini-slings tightly so that the sling was directly opposed to the urethra such that a spacer could not be placed between the sling and the urethra.[13] All patients underwent intraoperative cystoscopy at the end of the procedure. Performance of concomitant surgery was left to the discretion of the operating surgeon; however, surgeons were required to declare any concomitant surgery before opening the randomization envelope. Perioperative care and pain management were performed as per the routine at their study site.

After surgery, individuals were assessed at 6 weeks and at 6, 12, 18, and 24 months. Patients were asked to complete a daily diary during the first 2 weeks after surgery that assessed postoperative pain using the Surgical Pain Scales.[14] This scale was also completed at the 6-week postoperative visit. The Incontinence Severity Index, Pelvic Floor Distress Inventory-20, Pelvic Floor Impact Questionnaire-7, and Patient Global Index of Improvement[15] were completed at 6, 12, 18, and 24 months after surgery. At the 12-month and 24-month follow-up, individuals also underwent a pelvic organ prolapse quantification evaluation, completed the Prolapse/Urinary Incontinence Sexual Questionnaire-12, and completed a bladder diary.

The primary outcome for this study was subjective cure (absence of any urinary incontinence or retreatment) of urinary incontinence at 12 months after surgery. For this study, subjective cure is a composite outcome and was defined as absence of urinary incontinence as indicated by an Incontinence Severity Index score of 0 and the absence of any additional surgical or nonsurgical treatment for SUI after the index surgery. Incontinence severity was categorized ("dry," "slight," "moderate," and "severe") according to the Incontinence Severity Index results.[10] Patients were considered as having postoperative stress or urge incontinence symptoms based on their responses to corresponding items in the Pelvic Floor Distress Inventory-20.[11] Other secondary outcomes evaluated included short-term (less than 6 weeks) and long-term complications, postoperative pain and activity, change in symptom bother and quality of life (Pelvic Floor Distress Inventory-20, Pelvic Floor Impact Questionnaire-7), change in sexual function (Prolapse/Urinary Incontinence Sexual Questionnaire-12), and global improvement in bladder function (Patient Global Index of Improvement).

This study is a noninferiority study design. Based on criteria used in a previously published multicenter trial of mid-urethral slings, we chose a noninferiority margin of 12%.[5] Assuming subjective cure rate for TVT of 82%,[16] 127 individuals in each group will provide 80% to reject the null hypothesis (H0) that the true difference in cure rates between the two procedures (% cure TVT and % cure TVT SECUR) is less than or equal to 12% in favor of the alternate hypothesis (H1) that the true difference in proportions is greater than 12% using a two-group large-sample normal approximation test of proportions with a one-sided 050 significance level.[17] Assuming a 10% loss to follow-up or drop-out rate for the duration of the study, the total enrollment goal was 280.

To minimize bias toward a finding of noninferiority, data from women who were eligible and received the assigned surgery (per protocol) were used for the analysis of the primary outcome. The primary outcome is presented as the difference of proportions of individuals with subjective cure in each group (TVT minus TVT SECUR). Cases of missing data that precluded an assessment of the primary outcome were considered failures for the primary analysis. The hypothesis of noninferiority of the two treatment groups was tested by comparing the lower limit of the two-sided 90% confidence interval (CI) (equivalent to a one-sided significance level of .05) of the difference in proportion with the margin set at −12%. Two-sided 95% CIs are also shown to allow comparison of our results to those of other studies. A secondary analysis of the primary outcome according to original treatment assignment (intent to treat) was also performed, as was standard superiority testing. Additionally, the primary outcome was compared using logistic regression analysis to adjust for study site, prolapse beyond the hymen, and concurrent hysterectomy. Secondary outcomes were analyzed using the intent-to-treat population. Survival curves were generated for the development of any subjective incontinence symptoms using the Kaplan-Meier method and comparisons were made using a two-sided log-rank test. For secondary outcomes, Pearson χ^2 test was used for categorical data, the Student t test was used for parametric continuous data, and Wilcoxon rank-sum test was used for ordinal or skewed continuous data. Change in quality of life and sexual function questionnaire scores was analyzed using repeated-measures analysis

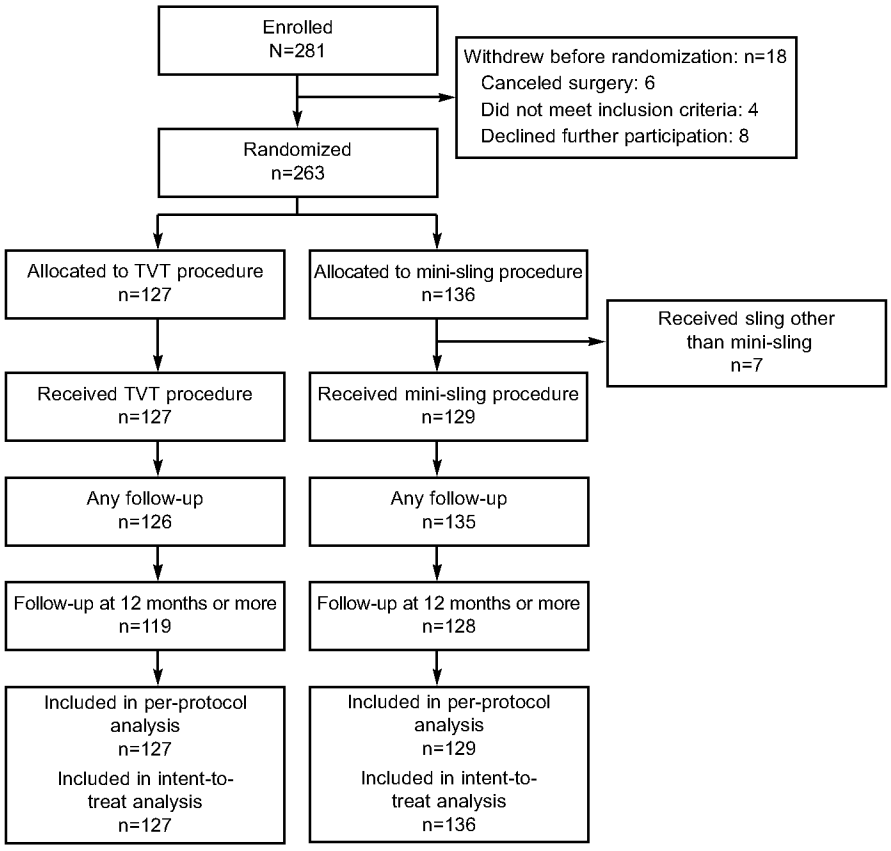

Fig. 1. Participant enrollment and follow-up. TVT, tension-free vaginal tape.

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of variance and overall change in these measures was assessed using the paired *t* test. Statistical analysis was performed with JMP 9.0 and NCSS 2007.

RESULTS

Two hundred eighty-one individuals were enrolled from seven U.S. medical centers between August 2007 and March 2010. A CONSORT flow diagram of individual enrollment and follow-up is shown in Figure 1. Eighteen individuals withdrew before randomization and are not included in the analysis. All participants allocated to TVT received the assigned intervention. Twelve individuals (8.8%) assigned mini-sling had technical difficulties or a device malfunction of the mini-sling at initial implantation that resulted in placement of TVT (n=6) or other retropubic mid-urethral sling (n=1) or use of a second mini-sling device (n=5) at the index surgery. In six of these cases, the surgeon was unable to obtain the requisite sling tension because of poor sling fixation in the retropubic space and in the remaining six cases one or more parts of the implantation device malfunctioned. Two hundred forty-seven individuals (94%) completed at least 12 months with mean follow-up of 19.6±7.7 months. Baseline demographic, clinical, and incontinence severity data were similar between the two groups (Table 1). The study population had a mean age of 55.3±10.9 years and 90% were white. Four individuals (1.6%) had undergone previous incontinence surgery and 27 individuals (10.2%) had undergone previous prolapse surgery. More than half of participants (53.4%) had severe urinary incontinence (Incontinence Severity Index score=8) at baseline.

A mini-sling or TVT was performed alone in 119 (45%), whereas the remainder underwent additional surgical procedures. Patients who received TVT were more likely to undergo concurrent hysterectomy (26% compared with 9%; *P*=.01) but no other differences in rates or types of concurrent surgery were noted (Table 2). Mean operating time, blood loss, and hospital stay were similar between groups (Table 3). The mini-sling group was more likely to be discharged without a catheter than those in the TVT group (78.5% compared with 63%; *P*=.008), but the median catheter duration was similar between groups (0 [range, 0–14] compared with 0.5 [range, 0–14]; *P*=.12). The mini-sling resulted in less pain for postoperative days 1–3 (median pain during normal activities scores for TVT SECUR compared with TVT:

Table 1. Participant Demographics

	Mini-Sling (n=136)	Tension-Free Vaginal Tape (n=127)	*P*
Age (y)	54.6±10.5	54.6±11.3	.97
Parity	2 (0–6)	2 (0–6)	.62
Body mass index (kg/m²)	29.6±6.4	30.0±5.7	.63
Menopausal status			
Premenopausal	42.2	42.6	.36
Postmenopausal with hormone therapy	18.8	23.8	
Postmenopausal without hormone therapy	39.1	33.6	
Race			
White	86.7	94.4	.10
African American	9.6	3.2	
Other	2.7	2.4	
Hispanic	2.2	1.9	.58
Insurance status			
Private or health maintenance organization	91.5	92.6	.74
Medicaid or Medicare	5.4	5.7	
No insurance	3.1	1.6	
Occupation			
Unemployed	9.3	8.8	.09
Sedentary	26.4	34.4	
Homemaker	18.6	20.0	
Light manual labor	34.9	20.0	
Heavy manual labor	10.9	16.8	
Charlson Comordibity Index score*			
0	85	88.9	.48
1	8.9	7.9	
More than 1	5.1	3.2	
Functional capacity† (metabolic units)	9 (4–10)	10 (1–10)	.55
Current smoker	13.0	5.6	.12
Current anticholinergic medication use for overactive bladder	7.8	4.6	.33
Previous hysterectomy	27.4	33.3	.30
Previous incontinence procedures‡	2.2	0.9	.39
Previous pelvic organ prolapse surgery	10.5	9.8	.87
Pelvic organ prolapse beyond the hymen	18.4	13.4	.27
Incontinence severity§			
Slight	3	3.2	.16
Moderate	36.8	46.4	
Severe	60.2	47.2	
Pads per day	8 (0–28)	8 (0–21)	.20
Pad use	81.4	78.2	.53
Type of incontinence symptoms			.95
Stress only	37		
Stress and urge	63		

Data are mean±standard deviation, median (range), or % unless otherwise specified.
* Charlson Comorbidity Index is calculated by assigning certain comorbidities a weighted value. The assigned values are added to give a total score.
† Functional capacity is expressed in metabolic units as determined by the Duke Activity Index.
‡ Previous incontinence procedures include retropubic colposuspensions and bulking agent injections.
§ Classifications as per Incontinence Severity Index ([10]).

day 1, 5 compared with 6; day 2, 4 compared with 5; day 3, 2 compared with 4; $P<.05$ for each), but no differences in pain scores were noted for days 4 through 14 or at week 6. Duration of pain medication use was similar between groups (median days of narcotic medication use, 1 [range, 0–16]; $P=.86$; median days of nonnarcotic pain medication use, 4 [range, 0–27]; $P=.89$).

One year after surgery, subjective cure was seen in 55.8% (72 of 129) of those who received a mini-sling and in 60.6% (77 of 127) of those who received TVT, with a mean difference of −4.8% (95% CI, −16.7% to +7.2%). The lower bound of the 90% CI is −14.9%, exceeding our predefined noninferiority boundary of −12%, so noninferiority was not demonstrated for the primary outcome. No significant differ-

Table 2. Concomitant Procedures Performed

	Mini-Sling (n=133)	Tension-Free Vaginal Tape (n=127)	P
Tension-free vaginal tape or mini-sling only	54 (40)	65 (52)	.06
Hysterectomy*	13 (9)	33 (26)	.01
Anterior colporrhaphy	27 (20)	17 (13)	.15
Paravaginal repair	1 (0.7)	1 (0.8)	.96
Anterior mesh	1 (0.7)	0 (0)	.33
Posterior colporrhaphy	19 (14)	20 (16)	.83
Posterior mesh	0 (0)	0 (0)	1.0
Vaginal vault suspension†	16 (12)	11 (9)	.34
Sacral colpopexy‡	5 (4)	5 (4)	.92
Colpocleisis	1 (0.7)	4 (3)	.15
Other§	19 (14)	17 (14)	.25

Data are n (%) unless otherwise specified.
* Vaginal, abdominal, or laparoscopic.
† Includes uterosacral vaginal vault suspensions, iliococcygeus suspensions, and sacrospinous ligament fixation.
‡ Abdominal or laparoscopic.
§ Other procedures include oophorectomy (n=8), hysteroscopic surgery (n=3), vulvar surgery (n=5), laparoscopic sterilization (n=1), lysis of adhesions (n=1), removal of vaginal polyp (n=1), removal of anal skin tag (n=1), ureteral reimplantation (n=2), ureteral stent (n=1), myomectomy (n=1), bladder biopsy (n=1), and anal sphincteroplasty (n=1).

ences in subjective cure were noted using standard superiority testing (*P*=.43). Adjustment for study site, concurrent prolapse surgery, and concurrent hysterectomy yielded similar results (odds ratio, 0.84; 95% CI, .49–1.4). Results using the intent-to-treat population were similar to those seen in the per-protocol population (Table 4). Incontinence severity 1 year after surgery was greater in the mini-sling group (mean Incontinence Severity Index score ± SD: 2.2±2.7 compared with 1.5±1.9; *P*=.015), resulting predominantly from a higher proportion of participants in this group with "severe" incontinence (Incontinence Severity Index=8) postoperatively (16% compared with 5%; *P*=.025; Table 4). Retreatment for stress incontinence occurred in 1.5% of the mini-sling group and in 2.4% of those in the TVT group (*P*=.43).

Bothersome stress incontinence symptoms were noted 1 year after surgery in 18% of those in the mini-sling group and in 14% of those in the TVT group (*P*=.36), and bothersome urge incontinence symptoms were seen in 25% and 29%, respectively (*P*=.54). No difference in incontinence episodes or pad use recorded on the bladder diary was seen between groups (Table 4). One year after surgery, 80% of individuals in the mini-sling group and 87% of individuals in the TVT group reported that their bladder symptoms were either "much better" or "very much better" on the Patient Global Index of Improvement (*P*=.64). Similarly, 91% of those in the mini-sling group and 94% of those in the TVT group indicated that they would "choose the same treatment if they had to do it all over again" (*P*=.36). Time to development of postoperative incontinence symptoms was not significantly different between the two groups (log-rank test *P*=.49; Fig. 2). Overall, there was a significant improvement in the urinary scales of the Pelvic Floor Distress Inventory-20 (Urinary Distress Inventory-6: mean change in score −33±24; *P*<.001) and the Pelvic Floor Impact Questionnaire-7 (Urinary Impact Questionnaire-7: mean change in score −23+22; *P*<.001), with no significant differences between groups. The Pelvic Floor Distress Inventory-20 and Pelvic Floor Impact Questionnaire-7 prolapse and colorectal scales and the Prolapse and Urinary Incontinence Sexual Questionnaire-12 scores all improved significantly without differences between the two groups (data not shown).

Patients receiving TVT were more likely to have a bladder perforation during sling placement than those in the mini-sling group. (4.8% compared with 0.8%; *P* =.046). All six bladder perforations in the TVT group were corrected intraoperatively by removing and replacing the bladder trocar, followed by 1–3 days of outpatient continuous bladder drainage. One individual in the mini-sling group with a history of previous retropubic colposuspension had bilateral bladder perforation with the mini-sling trocars, which

Table 3. Operating Room, Hospital, and Catheter Data

	Mini-Sling (n=133)	Tension-Free Vaginal Tape (n=127)	P
Anesthesia			
General	61.7	60.0	.32
Spinal	10.9	12.5	
Monitored anesthesia care or sedation	27.3	27.5	
Operating time for sling procedure (min)	26±12	28±10	.26
Total operating time (min)	77±81	77±70	.58
Estimated blood loss (mL)	50 (0–600)	50 (0–600)	.33
Discharged day of surgery	59.5	60.7	.60
Length of hospital stay (d)	0 (0–3)	0 (0–3)	.30
Catheter removed (normal voiding) before discharge	78.5%	63.0%	.008
Days until catheter removed	0 (0–14)	0.5 (0–14)	.12
Persistent voiding dysfunction*	2 (1.7)	3 (2.4)	.67

Data are %, mean±standard deviation, median (range), or n (%) unless otherwise specified.
* Voiding dysfunction defined as need for self-catheterization 42 days or more after surgery or urethrolysis.

Table 4. Efficacy Data at 1 Year

	Mini-Sling	Tension-Free Vaginal Tape	*P*
Subjective cure*			
Per protocol	72/129 (55.8)	77/127 (60.8)	.43
Intent to treat	77/136 (56.6)	77/127 (60.8)	.60
Incontinence Severity Index categories			
Dry	77/134 (57)	77/126 (61)	.025
Slight	12/134 (9)	18/126 (15)	
Moderate	24/134 (18)	25/126 (20)	
Severe	21/134 (16)	6/126 (5)	
Incontinence Severity Index score	2.2±2.7	1.5±1.9	.015
Retreatment for stress incontinence†	2/136 (1.5)	3/127 (2.4)	.43
Bladder diary			
Incontinence episodes per day	0 (0–1.8)	0 (0–1)	.41
Pads per day	0 (0–3)	0 (0–0.5)	.38
Using pads	29%	24%	.36
Stress urinary incontinence symptoms‡			
Any	21/109 (19)	15/103 (14)	.36
Bothersome§	20/109 (18)	14/103 (14)	.36
Urge urinary incontinence symptoms‖			
Any	30/108 (28)	33/103 (32)	.46
Bothersome§	27/108 (25)	30/103 (29)	.54
"Would choose same treatment"	76/107 (91)	95/101 (94)	.36
Patient Global Impression of Improvement			
Very much better	63/109 (58)	67/105 (64)	.64
Much better	24/109 (22)	24/105 (23)	
Somewhat better	11/109 (10)	9/105 (9)	
No different	3/109 (3)	1/105 (1)	
Somewhat worse	3/109 (3)	3/105 (3)	
Much worse	2/109 (2)	0/105 (0)	
Very much worse	3/109 (3)	1/105 (1)	

Data are n/N (%), mean±standard deviation, median (interquartile range), or % unless otherwise specified.
* Subjective cure: incontinence severity index score = 0 (dry) and no retreatment for stress incontinence.
† Retreatment: surgery or bulking agent injection.
‡ Participants were considered as having postoperative stress urinary incontinence symptoms if they answered affirmatively to the Pelvic Floor Distress Inventory-20 item, "Do you experience urine leakage related to physical activity, coughing or sneezing?"
§ Symptoms were considered bothersome if the participant indicated that she was bothered "somewhat," "moderately," or "quite a bit" on the corresponding item of the Pelvic Floor Distress Inventory-20.
‖ Participants were considered as having urge urinary incontinence symptoms if they answered affirmatively to the item, "Do you experience urine leakage related to the feeling of urgency?"

required inpatient hospitalization and continuous bladder irrigation for management of hematuria. Other intraoperative and postoperative complications were similar between groups (Table 5). Three ureteral injuries occurred in the mini-sling group that were unrelated to the sling procedure; one occurred during a laparoscopic hysterectomy and two were the result of transient ureteral kinking from a uterosacral vaginal vault suspension and were identified by cystoscopy intraoperatively and managed with suture removal. No mesh exposures were noted during follow-up in the mini-sling group; one individual in the TVT group had a mesh exposure noted at 6 weeks that was successfully managed with topical estrogen and observation. Sling release or urethrolysis to correct voiding dysfunction or persistent urge incontinence occurred in two participants in the mini-sling group (1.5%) and in three participants (2.4%) in the TVT group (*P*=.67).

DISCUSSION

Since 2006, several single-incision mini-slings have been introduced for the treatment of SUI. The intent of these smaller slings that are placed through a single suburethral incision and avoid passage of trocars through the retropubic or transobturator space is to decrease pain and potential adverse events relative to standard retropubic or transobturator mid-urethral slings.[18] The mini-sling device used in this study is unique in that it can be placed either in the transobturator-like "hammock" configuration or in a retropubic "U" configuration, where the self-fixing fleece pads are placed into the retropubic space on either side of the urethra in direct contact with the pubic

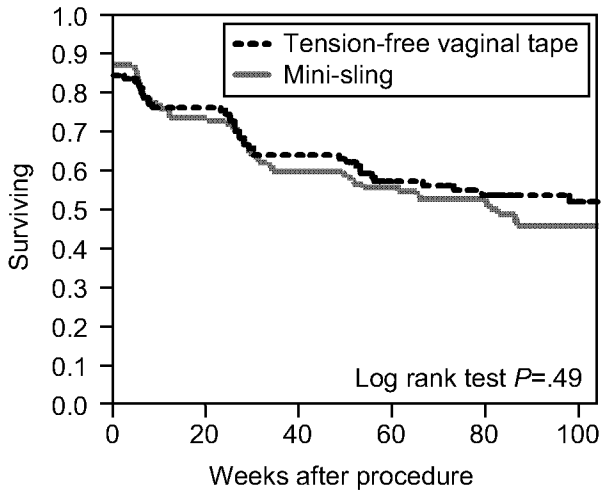

Fig. 2. Kaplan-Meier survival curve for the development of any urinary incontinence symptoms after surgery by procedure.

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symphysis. A search of MEDLINE (2006–June 2011; search terms: TVT SECUR, mini-sling, single-incision sling, sling, and SUI) identified no previous randomized trials that have directly compared a mini-sling placed in the "U" position with a standard retropubic or transobturator sling.

In this trial, subjective cure rates were similar between the two procedures but the mini-sling placed in the"U" position did not perform well enough to be able to confirm that its efficacy is not inferior to TVT by more than 12%. Moreover, individuals who received a mini-sling had greater severity of their urinary incontinence 1 year after surgery, with a substantially higher rate of severe (ie, daily) urinary incontinence. In essence, the proportion of patients who were completely continent after surgery was similar between the two procedures but, of those not continent, incontinence severity was significantly worse in those who received a mini-sling. Another disadvantage of the mini-sling seen in this study is a relatively high proportion (8.8%) of device malfunction or technical difficulties seen at implantation requiring use of a second mini-sling device or alternate sling. The advantages of mini-sling seen in this trial are a lower rate of bladder perforation, a higher rate of being discharged without a catheter, and less pain in the first 3 days after surgery than with TVT. It is unclear if these advantages are sufficient to balance a higher rate of postoperative incontinence severity seen with this procedure. Physicians will need to counsel patients carefully about these risks and benefits when contemplating placing a mini-sling.

Early experience suggested that mini-sling requires significantly more sling tension against the urethra than is typically recommended for TVT or other standard retropubic or transobturator slings that are placed "tension-free."[13] As a result, all mini-slings in this trial were tensioned tightly so that the sling directly opposed the urethra and the underside of the urethra at placement. Whether the lower subjective cure rate for TVT SECUR relative to TVT seen in other studies is a result of inadequate sling tensioning or placement of the sling in the hammock rather than the "U" position is unknown.

Complete resolution of SUI symptoms 1 year after surgery was seen in 81% and 86% of individuals in the mini-sling and TVT groups, respectively; however, the proportion of individuals with complete subjective continence was considerably lower. Overall, 59% of individuals were dry according to the Incontinence Severity Index, with an additional 12% reporting "slight" incontinence (drops of urine one or several times per month or more than drops less than monthly). Although these subjective cure rates seem relatively low, they are consistent with several recent large randomized trials evaluating SUI surgery, including a randomized trial of TVT and transobturator tape performed by members of our group.[4,5,19,20] Success rates for stress incontinence surgery vary widely and depend highly on the outcome measure and definition of cure used.[19,20]

One of the particular strengths of this study was the masking of participants and outcome evaluators to the treatment assignment. Patients in the mini-sling group received sham suprapubic skin incisions to mimic those of the TVT, and all outcome assessments were made by research staff who were blinded to treatment assignment. Masking the treatment assignment avoids, among other things, any potential bias the patient or research staff may have for or against "newer" or less established procedures.[21] This is particularly important when the outcomes are subjective, as in this study. The sham incisions performed in the mini-sling group may have minimized potential advantages in postoperative pain for this procedure, however. Other strengths of this study include its large sample size, multicenter nature, and use of multiple validated outcome measures. The principal limitation is its medium-term follow-up. Longer follow-up is necessary to properly evaluate the durability and long-term safety of the mini-sling procedure. Additionally, this study is underpowered to detect differences in rare but important complications like neurologic injury or mesh erosion.

Over the past 15 years, the widespread adoption of mid-urethral slings has revolutionized the SUI

Table 5. Intraoperative, Postoperative, and Long-Term Complications, Including Reoperations

	Mini-Sling (n=136)	Tension-Free Vaginal Tape (n=127)	*P*
Intraoperative complication			
Blood transfusion	1 (0.8)	0 (0)	.97
Bladder injury	1 (0.8)	6 (4.8)	.046
Vaginal wall perforation	0 (0)	0 (0)	1.0
Urethral injury	0 (0)	0 (0)	1.0
Ureteral injury	3 (2.6)	0 (0)	.25
Bowel injury	1 (0.8)	2 (1.6)	.61
Postoperative complications at 6 wk or less*			
Infection requiring antibiotics†	5 (3.8)	6 (4.8)	.76
Urinary tract infections	9 (6.7)	9 (7.2)	.89
Cardiac or myocardial infarction	0 (0)	0 (0)	1.0
Neurologic	0 (0)	0 (0)	1.0
Pulmonary	0 (0)	1 (.80)	.48
Ileus or small bowel obstruction	0 (0)	0 (0)	1.0
Pelvic abscess	0 (0)	0 (0)	1.0
Blood transfusion	1 (0.8)	0 (0)	.97
Venous thromboembolism	1 (0.8)	0 (0)	.97
Return to operating room	0 (0)	1 (0.8)	.48
Hospital readmissions	2 (1.5)	2 (1.6)	.94
Emergency room evaluations	6 (4.6)	5 (4.1)	.85
Unplanned clinic visit‡	24 (18.5)	20 (16.3)	.64
Long-term complications (more than 6 wk)			
Infection requiring antibiotics†	0 (0)	0 (0)	1.0
Cardiac or myocardial infarction	0 (0)	0 (0)	1.0
Neurologic	0 (0)	1 (0.9)	.32
Pulmonary	0 (0)	0 (0)	1.0
Ileus or small bowel obstruction	0 (0)	0 (0)	1.0
Pelvic abscess	0 (0)	0 (0)	1.0
Mesh exposure	0 (0)	1 (0.9)	.32
Leg pain or difficulty ambulating	1 (.9)	0 (0)	.69
Fistula	0 (0)	0 (0)	1.0
Reoperations			
Incontinence surgery§	2 (1.5)	4 (3.1)	.43
Sling release or urethrolysis	2 (1.5)	3 (2.4)	.67
Prolapse surgery	0 (0)	1 (0.8)	.46

Data are n (%) unless otherwise specified.
* Postoperative complications include all complications after surgical procedure but within the 6-wk postoperative period.
† Excludes urinary tract infections requiring antibiotics.
‡ Any clinic visit other than planned postoperative visit or for removal of catheter.
§ Includes bulking agent injections.

surgery. Whether placed via the retropubic or transobturator approach, these slings are as effective as more traditional incontinence procedures but with fewer complications.[1,2] Continued innovation in this field, including the introduction of single-incision slings, has been directed toward decreasing complications even further and improving the patient experience in terms of anesthesia requirements, decreased postoperative pain, quicker recovery, and less voiding dysfunction. In this study, the mini-sling placed in the "U" position demonstrated similar cure rates to those of TVT. The minor improvements in complication rates and the postoperative patient experience demonstrated by TVT SECUR seem to be overshadowed by a significantly greater incontinence severity after surgery, however. This highlights the need for rigorous clinical trials evaluating the efficacy and safety of new innovations in treatment for SUI relative to standard retropubic or transobturator mid-urethral slings before widespread adoption.

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